Appendix 2

VNTSC Certification Validation Package

In order to effectively validate adjustment procedures used by applicants for aircraft noise certification, the Volpe National Transportation Systems Center's Acoustics Facility ("VNTSC") requests that detailed information, as described herein, be supplied by the applicant. This information will be processed by VNTSC in accordance with the requirements of Federal Aviation Regulation (FAR) Part 36, to verify that the applicant's adjustment procedures are valid.

Applicants should note that the Volpe Center has detailed requirements for the data sets to be supplied, which in some cases exceed the reporting requirements for certification. This is necessary for accurate duplication of the applicant's procedures and to obtain meaningful results for evaluation. Complete data sets are required for three representative events: one each for approach, takeoff, and sideline-takeoff types for fixed-wing aircraft, and one each for approach, takeoff, and level flyover for helicopters. In addition to the listed information, the applicant must provide completed copies of the attached data forms, with information for each of the three events.

Each applicant must provide the following data:

(1) A flow diagram and/or description of measurement, analysis and adjustment systems, including system characteristics. **(Data Form 1 must be completed.)**

(2) An uncorrected, contiguous one-third octave-band sound pressure level time-history for each event (ANSI/ISO bands 17-40, nominal center frequencies of 50 Hz to 10 kHz, inclusive). The following must also be included:

- (a) Time at start of first data record for each event (A common time base must be used to synchronize acoustic, tracking, and meteorological measurements)
- (b) Elapsed time between data records
- (c) Type of time-averaging (linear/exponential)
- (d) Averaging period

(3) A one-third-octave-band data record of pre-detection noise, including the ambient noise conditions at the test site, and electronic instrumentation noise floor (one for each event and site combination submitted).

(4) A one-third-octave-band data record of the post-detection noise at the sensitivity settings at which the individual event was processed (one for each event/site/system combination submitted).

(5) Meteorological data (i.e., temperature and relative humidity) versus altitude (per event) as used in processing for determining propagation time, absorption, etc. A description of the meteorological data must be supplied, specifying any post-processing that was performed (such as smoothing, layering, time interpolation, or altitude extrapolation) on the measured data prior to reporting. At a minimum the temperature and humidity measured at 10 meters and at altitude must be supplied for each event. The time-of-day associated with each meteorological data set must be provided.

(6) Aircraft position and performance data (TSPI - Time Space Position Information) for each event, including XYZ coordinates referenced to the centerline microphone location. A description of the tracking data must be supplied, specifying any post-processing that was performed (such as

smoothing, curve-fitting, straight-line approximation, etc.) on the measured data prior to reporting. At a minimum the following performance data must be supplied:

(a) Aircraft altitude at overhead
(b) Ground speed [V_g]
(c) Climb/descent angle [Φ]
(d) X- and Y-offset or ground-track horizontal cross-angle [
(e) Time at overhead [T_{oh}]

(See the attached Figure 1.)

Also, any additional elements used in the calculation of propagation distance, emission time, or emission angle, (such as yaw or pitch) must be specified, as well as the processes used to apply them. **(Data Form 2 must be completed.)**

(7) Any adjustments applied to the raw one-third-octave-band spectral data, including:

(a) System adjustments for deviation from flat frequency response (pink noise test)
(b) Microphone pressure-response and free-field sensitivity adjustments (including incidence-dependent adjustments over a range of angles, if applicable)
(c) Microphone wind screen insertion loss adjustments
(d) Analyzer bandwidth error adjustments
(e) Calibrator drift adjustment
(f) Calibrator atmospheric pressure adjustment
(g) System gain-change adjustment
(h) Other adjustments, e.g., high-altitude jet noise adjustment

(8) A description of any adjustment process used to correct the acoustic data for background noise effects, including:

(a) Correction for effects of pre-detection noise
(b) Determination of masking criteria
(c) Type of reconstruction used for masked, high-frequency data (e.g., frequency and/or time extrapolation utilizing atmospheric absorption, fixed-rate dB per one-third octave-band sloping, etc.)
(d) Handling of masked low frequency data
(e) Identification of masked/sloped data
(f) Identification of records containing too many masked bands to be processed

(9) If used, a description of computer averaging applied to linear data to achieve Slow exponential response after analysis, including type of averaging and values for weighting (e.g., four-sample weighted logarithmic averaging with coefficients of n1, n2, n3, and n4).

(10) If reconstruction is performed using time and/or frequency extrapolation, or if the "Integrated" Procedure is used for adjustment to Reference-Day Conditions, a time-history of processed aircraft geometric data (XYZ emission coordinates, emission angle, elevation angle, and propagation distance relative to the microphone, at time of emission for each acoustical data record within the EPNL duration) must be provided.

(11) A description of the tone-correction process used, including any upper and lower frequency limits, exclusion of tones in masked bands, special handling of pseudotones, etc.

(12) A time-history of Test-Day "adjusted as-measured", contiguous, one-third-octave-band data records along with calculated PNL, and PNLT values, and frequency of maximum tone correction for each record. Additionally, the test-day EPNL, band-sharing adjustment, and time

of $PNLT_{max}$ record (midpoint of the averaging period) must be included. The $PNLT_{max}$ record, the 10 dB down records, and secondary peaks within 2 dB of $PNLT_{max}$ must also be identified. **(Data Form 3 must be completed.)**

(13) Parameters used for adjustment to Reference-Day Conditions, including:

(a) Reference altitude
(b) Reference ground speed [V_{gref}]
(c) Reference climb/descent angle [φ_{ref}]
(d) Reference receiver offset from reference ground track

(Data Form 2 must be completed.)

(14) Identification of process to be validated for adjustment to Reference-Day Conditions: "Simplified" Procedure, "Integrated" Procedure, or both.

(14.1) The following data are required for validation of the "Simplified" Procedure:

(a) $EPNL_{REF}$: Reference-Day EPNL
(b) Del(1)= Reference-Day $PNLT_{max}$- test-day $PNLT_{max}$
(c) Del(2):
fixed-wing =$-7.5\log(SR/SRR)+10\log(V_g/V_{gref})$
helis = $-10\log(SR/SRR)+10\log(V_g/V_{gref})$
(d) Del(peak): correction resulting from secondary as-measured peaks within 2 dB of $PNLT_{max}$
(e) Del(bndshr): band sharing adjustment
(f) $PNLT_{max\ REF}$: Reference-day $PNLT_{max}$
(g) For $PNLT_{max}$ and any peaks within 2 dB of $PNLT_{max}$, the following must be provided:
- Reference-Day PNL, PNLT, and maximum tone correction frequency band
- Reference-day one-third-octave-band spectrum
- Track data at emission time (i.e., slant range [SR_e]; emission angle [θ_e]; elevation angle [$_e$]; XYZ coordinates; and reference slant range [SRR_e]

(Data Form 4a must be completed.)

(14.2) The following data are required for validation of the "Integrated" Procedure:

(a) $EPNL_{REF}$: Reference-day EPNL
(b) $PNLT_{maxREF}$: Reference-day $PNLT_{max}$
(c) Maximum tone correction value and frequency band for Reference-Day $PNLT_{max}$
(d) A time-history of Reference-Day, contiguous one-third-octave-band data records with calculated PNL, PNLT, maximum tone correction frequency, and the calculated effective duration time for each record
(e) A time-history of reference track coordinates at reference emission time (i.e., reference slant range [SRR_e]; and reference XYZ coordinates
(f) Identification of the Reference-Day $PNLT_{max}$ and 10 dB-down records
(g) Del(bndshr)REF: Reference-Day band sharing adjustment

(Data Form 4b must be completed.)

Both hardcopy and MS-DOS-compatible ASCII text file versions of all data are required. All noise level data must be provided to the nearest .01 dB. Finally, a technical point-of-contact must be identified by each applicant.

All questions should be referred to:

Gregg G. Fleming
Manager, Acoustics Facility
U.S. Department of Transportation
Volpe National Transportation Systems Center
Kendall Square
Cambridge, MA 02142
(617) 494-2876
(617) 494-3208 (FAX)

Attachments

[insert Draw Perfect file FIG1.WPG here]

Form 1

MEASUREMENT & ANALYSIS SYSTEMS

APPLICANT _____

TEST DATE (MM/DD/YY) _____/_____/_____

AIRCRAFT DESIGNATION_____

Site ID		C1	S1	S2
Site Coordinates: Distances in Feet Relative to Site C1 (See Figure 1)	X	0.0		
	Y	0.0		
	Z	0.0		
Site Elevation (Feet MSL)				
Microphone Height (Feet AGL)				
Mic. Orientation re: Flight Path (ie: grazing, normal to CPA, normal to overhead, etc.)				
Microphone Manufacturer & Model				
Windscreen Manufacturer & Model				
Recorder Manufacturer & Model				
Calibrator Manufacturer & Model				
Analyzer Manufacturer & Model				
Analyzer Averaging Time Period				
Analyzer Avg. Mode (linear/exp.)				
Tone Correction Lower Limit (Hz)				
Other Adjustment(s)				

Form 2

FLIGHT PERFORMANCE & OPERATION

APPLICANT _____

TEST DATE (MM/DD/YY) _____/_____/_____

AIRCRAFT DESIGNATION _____

Event ID				
Event Type (T/O, Approach, Sideline)				
Time at Overhead [T_{oh}] (HH:MM:SS.SS)				
Altitude at Overhead (Feet AGL)				
Reference Altitude (Feet AGL)				
Ground Speed [V_g] (Knots)				
Ref. Groundspeed [V_{gref}] (Knots)				
Climb/Descent Angle [ ] (Degrees)				
Ref. Climb/Descent Angle [$_{ref}$] (Deg.)				
Horizontal Cross Angle [ ] (Degrees)				
X Offset (Feet)				
Y Offset (Feet)				
Reference Microphone Coordinates (Feet)	X			
	Y			
	Z			

See Figure 1

Form 3

DATA PROCESSING RESULTS - TEST-DAY "ADJUSTED AS-MEASURED"

APPLICANT _____

TEST DATE (MM/DD/YY) _____/_____/_____

AIRCRAFT DESIGNATION_____

Event ID			
Site ID			
Number of Raw Data Records			
Time @ Start of First Raw Data Record (HH:MM:SS.SS)			
Time @ $PNLT_{max}$ (HH:MM:SS.SS)*			
$PNLT_{max}$ Record Number			
First 10dB-down Record Number			
Last 10dB-down Record Number			
EPNL			
$PNLT_{max}$			
PNL_{max}			
LA_{max}			
Tone Correction Band @ $PNLT_{max}$			
Del(bndshr)			
Record Numbers of Peaks Within 2dB of $PNLT_{max}$			

*Time at Midpoint of Averaging Period

Form 4a

PROCESSING RESULTS - ADJUSTMENT TO REFERENCE-DAY CONDITIONS

"Simplified" Procedure

APPLICANT _____

TEST DATE (MM/DD/YY) _____/_____/_____

AIRCRAFT DESIGNATION_____

Event ID			
Site ID			
$PNLT_{max\ REF}$			
$EPNL_{REF}$			
Tone Correction @ $PNLT_{max\ REF}$			
Tone Correction Band @ $PNLT_{max\ REF}$			
Slant Range [SR_e] @ $PNLT_{max\ REF}$			
Ref. Slant Range [SRR_e] @ $PNLT_{max\ REF}$			
Emission Angle [$_e$] @ $PNLT_{max\ REF}$			
Elevation Angle [$_e$] @ $PNLT_{max\ REF}$			
X_e Coordinate @ $PNLT_{max\ REF}$			
Y_e Coordinate @ $PNLT_{max\ REF}$			
Z_e Coordinate @ $PNLT_{max\ REF}$			
Del(1)			
Del(2)			
Del(peak)			
Del(bndshr)			

Form 4b

PROCESSING RESULTS - ADJUSTMENT TO REFERENCE-DAY CONDITIONS

"Integrated" Procedure

APPLICANT _____

TEST DATE (MM/DD/YY) _____/_____/_____

AIRCRAFT DESIGNATION_____

Event ID			
Site ID			
$PNLT_{max\ REF}$			
$EPNL_{REF}$			
Time @ $PNLT_{max\ REF}$ (HH:MM:SS.SS)*			
$PNLT_{max\ REF}$ Record Number			
First 10dB-$down_{REF}$ Record Number			
Last 10dB-$down_{REF}$ Record Number			
Tone Correction @ $PNLT_{max\ REF}$			
Tone Correction Band @ $PNLT_{max\ REF}$			
Slant Range [SR_e] @ $PNLT_{max\ REF}$			
Ref. Slant Range [SRR_e] @ $PNLT_{max\ REF}$			
Emission Angle [$_e$] @ $PNLT_{max\ REF}$			
Elevation Angle [$_e$] @ $PNLT_{max\ REF}$			
X_e Coordinate @ $PNLT_{max\ REF}$			
Y_e Coordinate @ $PNLT_{max\ REF}$			
Z_e Coordinate @ $PNLT_{max\ REF}$			
Del(bndshr)REF			

*Time at Midpoint of Averaging Period

Form 5

CHECKLIST

1.[] Complete Form 1

2.[] Supply Flow Diagram and/or description of measurement, analysis & adjustment systems.
Letter Item 1

3.[] Supply 1/3 Octave Uncorrected Noise Data
Letter Item 2

4.[] Supply 1/3 Octave Ambient Noise Data
Letter Item 3

5.[] Supply 1/3 Octave Instrumentation Floor Noise Data
Letter Item 4

6.[] Supply Meteorological Data
Letter Item 5

7.[] Supply Aircraft Positional Data
Letter Item 6

8.[] Complete Form 2

9.[] Supply 1/3 Octave System Adjustment (Pink Noise) Data
Letter Item 7.a

10.[] Supply 1/3 Octave Microphone Sensitivity Adjustment Data
Letter Item 7.b

11.[] Supply data and description of any other adjustments applied to obtain "adjusted as-measured" data, including procedures to correct for background noise effects.
Letter Items 7 - 11

12.[] Supply 1/3 Octave Test-day "adjusted as-measured" Noise Data
Letter Item 12

13.[] Complete Form 3

14.[] Supply description of computer processing characteristics and methodology used to adjust data to Reference-day conditions, including reference parameters.
Letter Item 13

15.[] Supply 1/3 Octave Reference-day Noise Data:
- Entire event, if using "integrated" procedure
- $PNLT_{max}$ record (and records for peaks within 2dB of $PNLT_m$ if applicable), if using "simplified" procedure

Letter Items 14.1.g/14.2.d

16.[] Supply Tracking Data:
- Entire event, if using "integrated" procedure
- $PNLT_{max}$ point (and records for peaks within 2dB of $PNLT_m$ if applicable), if using "simplified" procedure

Letter Items 14.1.g/14.2.e

17.[] Complete Form 4

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